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STUDY TRIP IN THE USSR

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ABSTRACT. A brief outline of Soviet computer applications in administrative services and various enterprises is given with special attention to training and apportionment of personnel. Technical notes on the Ural, Minsk, Onega, and Besma series computers are appended.

Organized from 3 to 12 September by the French Mechanography Association (FMA), the trip in which Mr. Bancarel took part was under the aegis of the International Exposition of Means of Mechanizing Technical, Administrative, and Managerial Work (Interorg Technika), which was held 1 to 15 September at Sokolniki Park, Moscow. /1*

Besides the visit to the exposition, the program included several professional visits and informative conferences on the techniques of automation in the Soviet Union.

There was some difficulty in carrying out the program, because of the size of the French group, 78 participants, including individuals of all different levels of knowledge of electronics, and because of the particularly heavy burden put upon the Soviet technicians, who were subject to very numerous requests for the duration of the exposition.

Furthermore, the absence of a means for simultaneous translation made the conferences and subsequent discussions long and difficult, since the interpreters had to have a perfect grasp of the technical terminology in both languages.

In these various respects, a considerable improvement of working conditions was to come during the second part of the trip as the result of an FMA delegation to the Soviet Vice-minister of Electronic Calculation and Automation Equipment, who intervened personally to provide the group every possible means for information.

Thus it was possible to make certain observations on the state of automated management in the Soviet Union:

--structure of materiel and applications,
--future perspectives, which seem largely open because of the effort presently being accorded for the formation of specialized personnel.

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* Numbers in the margin indicate pagination in the foreign text.

STATE OF AUTOMATED MANAGEMENT IN THE SOVIET UNION, IN THE ADMINISTRATIVE SERVICES AND IN THE ENTERPRISES

First, it must be emphasized that the Russians attach great importance to computers, which they wish to put in general service both in the administrative services and in the enterprises in order to "optimize" production. The fact that the Soviet Government, long before France, created a special ministry, that of Electronic Calculation and Automation Equipment, is in itself a phenomenon of significance. /2

The desire to use automation in quite diverse areas is firmly established, both in the field of economic organization of production and in the organization of distribution routes, especially for the supplying of large stores.

As for economic organization, the procedure is to collect data and process them so as to arrive at a choice of decisions and control of execution of the organization such that the whole procedure becomes an integral mechanism. Computers, classical mechanography, and electromechanics are employed at different levels, issuing from the enterprises, complexes, and administrative services to the statistical institutes of the federated republics, and from them to the Gosplan, which uses the electronic center at the Moscow National Statistics Institute*.

The structure of Soviet economy lends itself perfectly to extensive application of these methods, which can only be reinforced by the technological evolution which, in the next few years, will multiply the use of computers. Computers will be progressively substituted for all other materiel.

In the near future, the USSR for the first time will process the general population census by integral computer methods. Particular applications in the field of demography have already been carried out in Lithuania.

In industry, nation-wide specialized calculation centers are in operation in the construction of machine-tools and in the control of industrial fabrication processes.

In this respect, an interesting application was presented at the Sokolniki Part exposition with a Minsk 22 computer (cf. technical note attached).

In many areas, especially in the treatment of cellulose, which is of particular importance in the Soviet Union, production is controlled by Ural or Minsk type computers.

"Information" was applied to urban transit problems, especially with respect to the city of Moscow. All heavy transport means were regrouped. The daily passage of the 15,000 usable vehicles is regulated by one of the computers at the National Statistics Institute. Each day an optimal plan for city transit is edited by the computer based on a mathematical model, hourly frequency of predictable traffic, road work, snow, etc. Each day the users /3

* This center uses Minsk and Ural computers (cf. attached technical note) and Gamma 3 Bull calculators.

communicate their needs to the electronic center by telephone or mail. The transit means as well as the itineraries are furnished to the users by the Statistics Institute with a response delay from two to 24 hours, according to the urgency.

Already in general use in economic planning, increasingly used in industrial control and the field of distribution, scientific calculation electronics in the USSR is encountering a vast field of applications, which is constantly expanding to new areas.

Scientific calculation is the basis of automation development. In the USSR, the affiliation between scientific calculation and electronics applications is doubtlessly more apparent than in Western Europe.

The management computers, as can be seen, are derived from the scientific types, from which they do not differ greatly, especially with respect to the relative slowness of input and output. The few performances carried out on the various types mentioned are quite explicit as regards this factor.

No doubt in the years to come, along with the development of computers, these faults will be corrected, and the next generation of Soviet computers will present performances equal to those of the corresponding Western units.

As concerns scientific calculation, the use of computers is practically universal.

The Scientific Calculation Institute at the Moscow Academy of Sciences, which in the USSR corresponds with numerous identical institutes, offers a full gamut of applications.

Created in 1955, this institute is equipped with four computers, two cathode tube computers of the already old "Strella" type and two ferrite memory computers of the series BESM, BESM 3M, and BESM 6M.

The problems handled by the center involve:

--solution of problems of calculation technique,
--systems of differential equations,
--methods of probability and theory of numbers calculations,
--theory of elasticity and plasticity problems,
--seismic problems,
--astrophysics,
--gas dynamics,
--aerodynamics,
--hydrodynamic problems
--numerical methods for rare gases,
--cosmic equipment (calculation and change of trajectories),
--cosmic ballistics,
--operational research, nomography, special functions, numerical tables, /4
--algorithm for preparation of calculating machines,
--mechanical programming.

Furthermore, the institute is carrying out research with electronic computers on automatons as well as on physiological functions of man. A group of four scientists is especially devoted to this last subject.

In light of the few preceding observations, it can be seen that the USSR is about to effect a technological mutation in the use of computers for management purposes, having already developed the use of electronics in the scientific domain to the extreme limit.

The "banalization" of computers in the administrative, industrial, and commercial domain in the next few years, the high point of the "information" evolution in the USSR, is already underway, not only with respect to the construction of materiel, but also as concerns the training of specialized technicians.

The training of personnel capable of maximum use of the possibilities of the calculation units which will soon be put in service seems to be one of the dominant preoccupations of the Soviet directors.

It does not seem that the Western European governments have given an equal amount of attention to computer software. The training of personnel, at least for the present, cannot be carried out according to precise rules or long-range plans, so that too frequently the use of electronics has been compromised by the technical insufficiency of the specialists, who often tend to consider the computers at their disposition merely as improved classical calculating machines.

The Soviet Union does not seem liable to such dangers in the future. Presently, the formation of the specialized personnel is undertaken within the framework of a specialization instituted in a terminal class in the technical high schools.

Calculation institutes, created within the universities for the training of advanced groups, provide a four-year cycle of very advanced training for analyst-programmers. Shorter courses for programming and operators are also conducted at the university institutes for the personnel of the enterprises and administrative services: 10 months of training for programmers and 20 days for operators.

At the most advanced level, a very special sort of training has been instituted at the principal universities: Moscow, Leningrad, Kiev, and Novosibirsk. These universities offer a three-faceted training for electronics engineers: electronic, mathematic, and economic. /5

The duration of the course is five years. At the start, the students can opt between mathematics and economics; furthermore, they all take a common course of general culture, electronics, and economy.

The scientists who will later become specialists in electronics applications of scientific research are assigned a highly-advanced course of mathematics, 350 hours of pure mathematics during the three years of theory courses.

The economists who will later be employed in the services of the Plan and in the enterprises for the application of electronics take an extensive course of mathematical economics within the same three-year period.

After these three years, the students, within their respective specialties, undertake a practical stage, either in the institutes of scientific calculation, or in the services of the Plan, or the complexes and enterprises.

Each year 250 students leave these various institutes and obtain their engineering diploma.

The Russians deem this number insufficient, and consider it to represent only 20% of the desired amount.

The distribution of personnel between analysts and programmers in the Soviet Union is of interest, both for scientific and management programming. For scientific programming, there are 10 analysts for each programmer; for management programming, three to five analysts for each programmer.

This proportion, at least as far as management programming is concerned, is just about the inverse of the situation in France.

In the Soviet Union, programming seems to be understood as pure and simple translation into machine language of an analysis which is already very much advanced.

The respective parts given the two techniques are of significance, as well as the intellectual level attained by the Soviet technicans, among whom trained analysts are numerous, and the desire for security brought to the process. In effect, this can only gain in quality as a result of a preceding, well-developed analysis.

Thus it seems that the Soviet Union, after having obtained the appropriate human and materiel resources, is about to integrate closely the "informative" of its economic structures, of which all sectors will be controlled in a few years by technologically adapted computers, served by hundreds of thousands of technicians perfectly capable of utilizing the supply of computers at their disposition to their full capacity.

Doubtless, that is the reason for the interest evoked by the Interorg Technika exposition which, apart from 1000 exhibitors from 19 countries, attracted a great number of specialists from the Western nations as well as from the people's democracies. /6

During the visit of the FMA delegation to the Vice-minister for Electronic Calculation and Automation Equipment, the Russians were particularly interested in cooperation with France in the area of professional training, the elaboration of management systems, analysis, composition of programs, as well as scientific calculation.

Mr. Matkin, Vice=minister, proposed sending a mission to France for the occasion of the SICOB. Its purpose would be to explore the possibilities offered in these various areas.

TECHNICAL NOTES

The Russian computers have a structure and logic which is notably different from those of the computers used in the Western countries. As far as it can be summarized, their computers correspond to the second generation of Western units. /7

Use of magnetic circuits and transistorized bands is frequent. On the other hand, disks are not yet used, and no component handles selective access memory, which is the transition factor with the third generation of computers.

The computers are often conceived to handle a particular application, and in general are not appropriate for processing an extended range of problems. This phenomenon can be explained by the absence of concern about commercial rentability and the desire to satisfy the needs of a particular user as completely as possible.

Thus, a certain polyvalence can be observed on the level of the Minsk and Ural units, especially concerning the latter which can be used for scientific calculation as well as for management and control of industrial processes.

A. The Ural Series

This series of computers includes several units, 11, 14, and 16, which offer different levels of performance.

The computer presented at the exposition, Ural 11, which is also in service at the National Statistics Institute, is a unit which offers interesting performance. It can be used equally well for scientific and technical calculation and management or control of industrial processes.

The characteristics of the unit are as follows:

--central transistorized memory: 4,096 to 16,384 words of 24 bits,
--124 instructions,
--binary and decimal information,
--stable comma only,
--magnetic bands: free 100 meters, reel 350 meters,
--50,000 operations per second.

The unit uses both cards and perforated tape, and includes a printout.

B. Minsk Series

The Minsk units also cover a rather wide range of applications. They are found in use for problems of scientific calculation as well as for the classification of documentation in Russian and other languages, the control of plannings and the initiation of fabrication or economic planning. /8

The Soviet National Statistics Institute uses a Minsk 22 unit, identical to that presented at the Interorg Technika exposition.

The Minsk 22 is a scientific computer, the logic of which seems similar to that of IBM 704, 7040 and 7090 computers. Its performance is comparable to that of the IBM 1620.

The Minsk 22 offers the following technical characteristics:

--base time: 24 microseconds,
--5,000 to 6,000 operations per second,
--central memory: 2 blocks of 4,096 words of 36 bits,
--101 instructions,
--2 addresses,
--stable comma and floating comma (10^{-19} to 10^{+19}),
--internal representation: binary,
--support representation: decimal, octal, alphanumerical,
--external memory: 1,600,000 words,
--card reading: 250/minute,
--alphanumerical printout with 128 characters per line, 300 lines per minute.

For certain applications, intermediate languages, such as autocoder, might exist. Details on this matter could not be obtained.

The applications presented at the Interorg Technika consisted, first, of the classification of scientific and technical bibliographies in Russian and other languages, with selection of documents at the speed of 3,000 per second; and second, of control of planning and fabrication startup.

About a hundred Minsk units are used for this last type of operation.

C. Onega Series

The Onega unit is a teleprocessing system used in the Soviet postal service for the sending of mandates and the resulting centralization operations.

The territory of the Soviet Union is divided into 16 postal regions, each one provided with a central Onega 2 unit connected to peripheral Onega 1 units. An Onega 2 can handle 150 peripheral Onega 1 units.

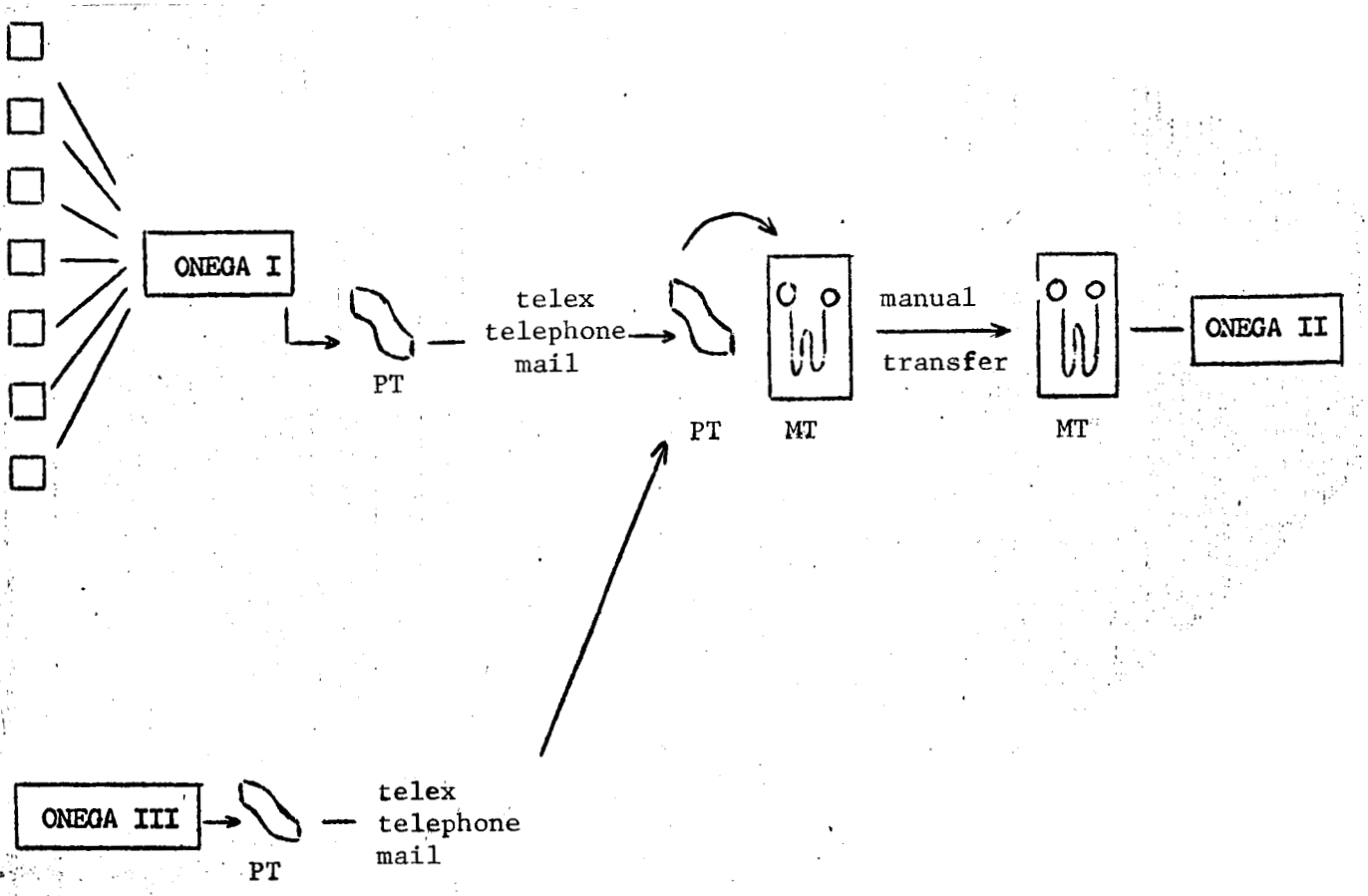
Onega 1 is a small computer used to centralize and perforate on tape the information put in by means of the seven keyboards which can be connected to it. /9

In small post offices, Onega 3 units are used; these are electromagnetic machines with tape perforaters.

The tapes perforated by the Onega 1 and 3 units are transmitted by telegraph or post to the central Onega 2 unit.

A unit independent of the central computer handles translation of the perforated tape into a magnetic band, which is then processed by Onega 2.

The system functions in only one direction, and does not allow transmission of information from the central unit to the peripheral units.



The characteristics of the Onega system are as follows:

ONEGA 1

--central memory: 100 words of 8 binary positions,
--arithmetic and percentage calculation operations,
--stable comma,
--printout: 150 lines per minute,
--tape perforaters: 1,200 lines per minute (5 channels),
--seven keyboards can be connected to this unit.

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ONEGA 2

--central memory of 400 to 1000 x 13 binary positions,
--words of 13, 26, or 39 binary positions,
--decimal representation,
--stable comma,
--perforated tape reading: 200 lines per second,
--printout: 300 lines per minute,
--10 reels of magnetic bands possible (width: 35 mm; length: 560 m).

ONEGA 3

--electromagnetic machine with: 14 addition counters, 10 counters for other operations.

This system constitutes a network of medium-power, interconnected computers.

The idea used, which supposes a rather large deconcentration of central units, was probably selected because of the extreme distances between points to be served. In a Western version, the processing function probably would be centralized in a single computer.

D. BESM Series

The BESM units are scientific calculation computers, one of which, the BESM 4 (comparable to the IBM 7040), can be used in management, despite a limited performance with respect to speed of input and output: 300 lines per minute printout, 15,000 characters per second on magnetic bands.

This unit was presented at the Interorg Technika exposition.

The BESM 3M and 6M units, in service at the Scientific Calculation Institute of the University of Moscow, and which were examined more completely, can be used only for scientific calculation.

The BESM 3M is a medium class rapid electronic calculation machine with ferrites, and has been in use at the Scientific Calculation Institute for three years.

Its performance is as follows:

--capacity: 20,000 operations per second,
--3 addresses,
--magnetic bands and magnetic drums,
--words of 45 binary positions, /11
--floating comma,
--capacity of the four possible drums, 16,000 words x 4,
--possibility of four reels: 10^6 words x 4,
--central memory: 4,096 words,
--input: perforated cards = 250 cards per minute (control),
--output: printout = 20 lines per second (1,200 lines per minute),
1 line = 1 number = 16 characters,
perforated cards = 50 cards per minute (no control),

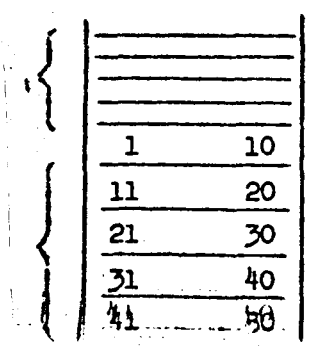
--magnetic bands: 4 channels, double and parity.

Information is in pure binary; the results come out in decimal. The information is registered in double on a same section, and this allows immediate execution of control operations. This computer offers no simultaneity.

BESM 6M

This is a large transistorized machine with a tremendously large memory (which can be put in fiche form), which represents a considerable encumberment:

--10^6 operations per second,
--multiprogramming,
--central memory of 8 blocks of 4,096 words with memory protection keys,
--base cycle: 2 microseconds,
--words: 50 binary positions,
--registers: 16 words, access: 0.3 microseconds,
--capacity of 16 magnetic drums of 32 k,
--capacity of 32 magnetic bands of 10^6 words,
--16 magnetic drums are on 2 directional channels,
--32 magnetic bands are on 4 directional channels,
--possibility of simultaneous function of 6 organs,
--input: perforated tape -- 2,000 lines per minute (optical)
perforated cards -- 700 cards per minute (mechanical),
--output: perforated cards -- 120 cards per minute,
perforated tape -- 1,200 lines per minute, 8 channels
printout -- 128 alphanumerical positions per line,
7 lines per second, telex,
--organization of information on magnetic bands.



1 word = 50 bits = 5 lines of 10 bits

Cadence: 25,000 lines per second

SOVIET PARTICIPANTS OF THE CONFERENCE /12

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Mrs. Vinocourt, professor of economic sciences at the Superior School of Finances.

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Professor Ditkine, adjunct-director of the center.

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Professor Modine, specialist in the use of computers for economic planning.

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